VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary, Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Written *Ex Parte* Submission, GN Docket No. 14-177; IB Docket Nos. 15-256 & 97-95; RM-11664; and WT Docket No. 10-112

Dear Ms. Dortch:

Inmarsat, SES, and O3b submit for inclusion in the above-referenced proceedings the attached U.S. contribution to a recent International Telecommunication Union Task Group 5/1 meeting. This document addresses sharing and compatibility between IMT-2020 terrestrial mobile systems in the 39 GHz frequency range with the Fixed Satellite Service (FSS). The study addresses separation distances between FSS receivers and mobile terrestrial base stations and user equipment.

The study is relevant for these proceedings in which the Commission is considering how FSS and terrestrial operations can co-exist in this frequency range. The document was thoroughly vetted during the U.S. National Committee process by all interested parties in the U.S., satellite and terrestrial, resulting in a consensus supporting submission of the document as a U.S. contribution to the ITU task group meeting. The study concludes that for operations in the 39 GHz band, a separation distance of approximately 1100 meters between an FSS earth station and a terrestrial mobile deployment will limit interference to the FSS earth station receiver to acceptable levels.

Please contact the undersigned if you have questions.

Respectfully submitted,

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Attachment

Radiocommunication Study Groups

Received: 7 September 2017

Document 5-1/108-E
11 September 2017
English only

United States of America

SHARING AND COMPATIBILITY STUDIES OF FSS (SPACE-TO-EARTH) AND IMT OPERATING IN THE 37-50.2 GHz FREQUENCY RANGE

Proposal

At its May 2017 meeting, Task Group 5/1 considered initial work on several studies relating to sharing and compatibility between IMT-2020 operating in the frequency band 37.5 – 43.5 GHz and the FSS operating in the frequency bands 37.5 – 42.5 GHz. The information for all studies was carried forward in the Chairman's Report (Annex 5 to Doc. 5-1/92), with the US contribution included as Study B. In this contribution, the United States of America proposes edits and additional material for the Study B.

ATTACHMENT

Sharing and compatibility studies of FSS (space-to-Earth) and IMT operating in the 37-50.2 GHz frequency range[1]

1/1 Technical Analysis

1/1.1 Study A

[No change to study A]

1/1.2 Study B

1/1.2.1 Introduction

This document introduces the sharing and compatibility study of IMT-2020 systems in the 37.5 – 42.5 GHz frequency range with FSS. The study investigates the effect of separation distances between the FSS receiver and the IMT-2020 base stations and user equipment.

1/1.2.2 Characteristics and cumulative distribution functions (CDFs) of IMT-2020

IMT-2020 system parameters and deployment scenarios to be used in the sharing and compatibility studies are found in the document "of terrestrial IMT systems for frequency sharing/interference analysis in the frequency bands between 24.25 GHz and 86 GHz" (Doc. 5-1/36, Attachment 2).

These CDF results are provided to be able to compare different simulator implementations of the IMT-2020 systems as outlined in section 8 of Recommendation ITU-R M.2101.

The assumptions used are:

1 One million snapshots are used to generate the CDFs;

2 e.i.r.p. densities are -35.6 dBm/Hz for BS and -50.9 dBm/Hz for UE;

3 Micro urban hotspot below the roofline scenario with BS height at 6 m and UE at 1.5 m. All BS and UE are outdoor. One square kilometre area includes six BS and three active UE per BS. The BS and UE are placed inside that area;

4 The location of BS and UE vary for each snapshot. The UE are distributed in the area defined by the BS azimuth coverage of 120° degrees and up to 100 m from the BS. The BS azimuth coverage direction is random for every snapshot;

5 20% network loading activity factor reduces the total number of active BS and UE by 80%;

6 The are 30 BS in km^2 and three UE that can be associated with each BS;

7 TDD factors reduces the simultaneous transmissions of BS 20% UE by 80%;

8 At each snapshot, the following parameters are randomized:

   a. Locations of BS an UE associated with that BS;

   b. Location of the FSS station for one scenario and fixed in locations for the other;

   c. BS and UE antenna elevation and azimuth angles within a given sector depending on the link using Beamforming antennae according to Recommendation ITU-R M.2101;

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[1] This annex includes studies between IMT-2020 and FSS (s-to-E) above 42.5 (up to 50.2) due to their similarity with studies from 37.5-42.5 GHz.

d. The BS and UE that are active (based on TDD factor);

e. The UE transmit power control level based on the UE proximity to the BS,

9 BS do not use power control in the downlink;

10 Reference emission bandwidth is 60 MHz for BS and UE;

11 The propagation model for the IMT-2020 system is from Doc. 5-1/36. Micro urban scenario is used with parameters from Recommendation ITU-R P.1411 “Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz”. The parameters for the non-line of sight path loss with the coefficients (from P.1411 Table 4) where α=5.06, β=-4.68, γ=2.02 and σ=9.33.

The results are presented as CDFs for:

1 BS antenna gain toward the UE,

2 UE uplink transmit power and

3 Downlink carrier-to-noise C/N ratio.

FIGURE 1

BS to UE antenna gain CDF

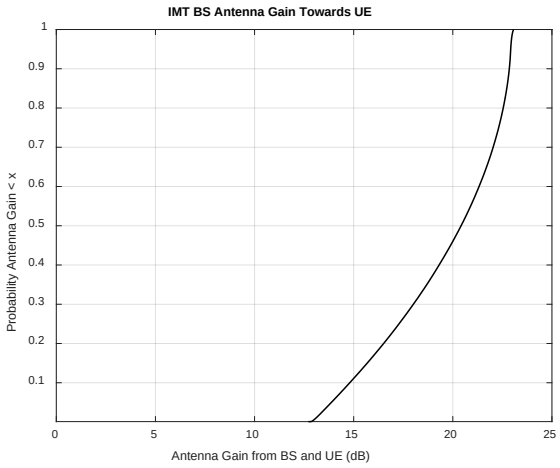


FIGURE 2

UE Uplink Transmit Power CDF

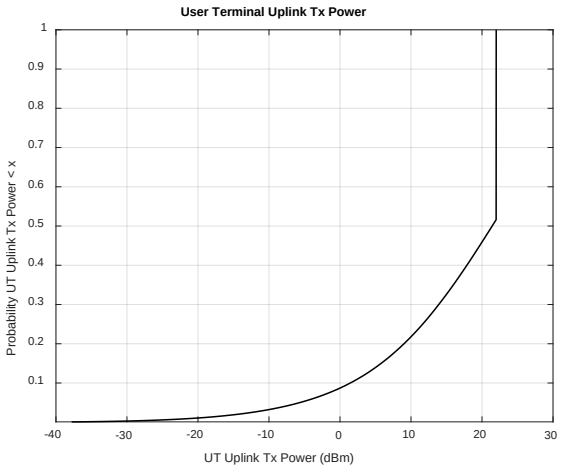
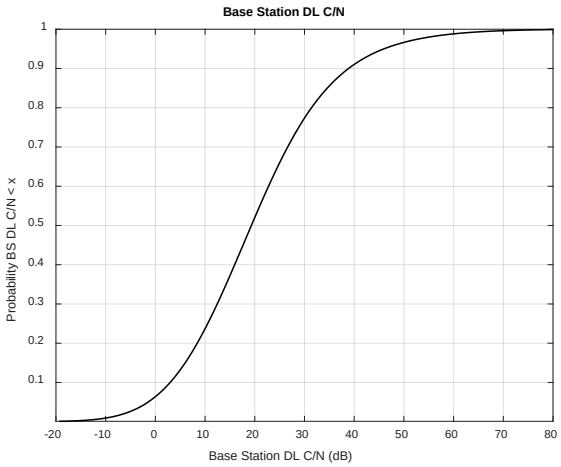


FIGURE 3

BS down link C/N



1/1.2.3 Characteristics of FSS systems

The FSS characteristics are from Document 5-1/25 and updated and streamlined in Document 5-1/89. The two FSS carrier parameters used in the analysis are shown in Table 1 below.

TABLE 1

FSS/BSS downlink parameters (Interfered with)

Parameter	**Unit**	**Carrier 26**	**Carrier 6**
Frequency range	GHz	37.5-42.5, 47.5-50.2	37.5-42.5, 47.5-50.2
Noise bandwidth	MHz	50-500	100-600
Earth Station Antenna diameter	m	1	6.8
Peak receive antenna gain	dBi	50	68
Antenna receive gain pattern	–	Rec. ITU-R 465-6	Rec. ITU-R 465-6
System receive noise temperature	K	150	250
Minimum earth station elevation angle	°	10 (35 nominal)	10 (35 nominal)
Interference to Noise Ratio I/N	dB	[-12.2, -10 and -6]	[-12.2, -10 and -6]

1/1.2.4 Analysis scenarios and assumptions

The IMT-2020 setup is as described above. For the interference analysis, we use three scenarios. These are:

1 Scenario-1: IMT-2020 and FSS are randomly placed for each snapshot as shown;

2 Scenario-2: IMT-2020 is randomly placed for each snapshot but the FSS is at a fixed position of 800 m from the centre of the IMT-2020 1 km^2 area distribution as shown.

3 Scenario-3: Same as scenario 2 except that the separation distance from the IMT-2020 1 km^2 area distribution is 1 100 m.

FIGURE 4

Scenario-1 Example of three snapshots showing the random placements of IMT-2020 in 1 km^2 area. The FSS stations are also randomly located with a 0.8 km radius from centre point

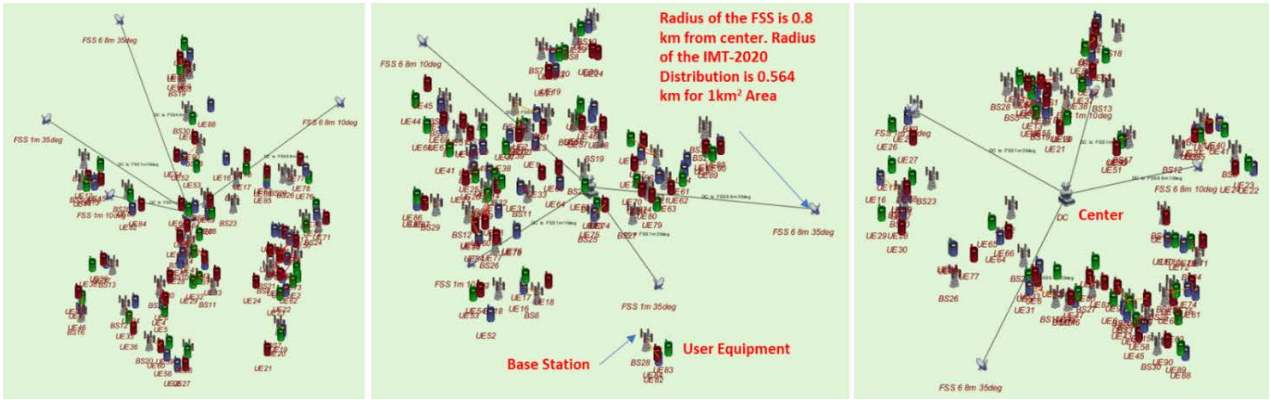
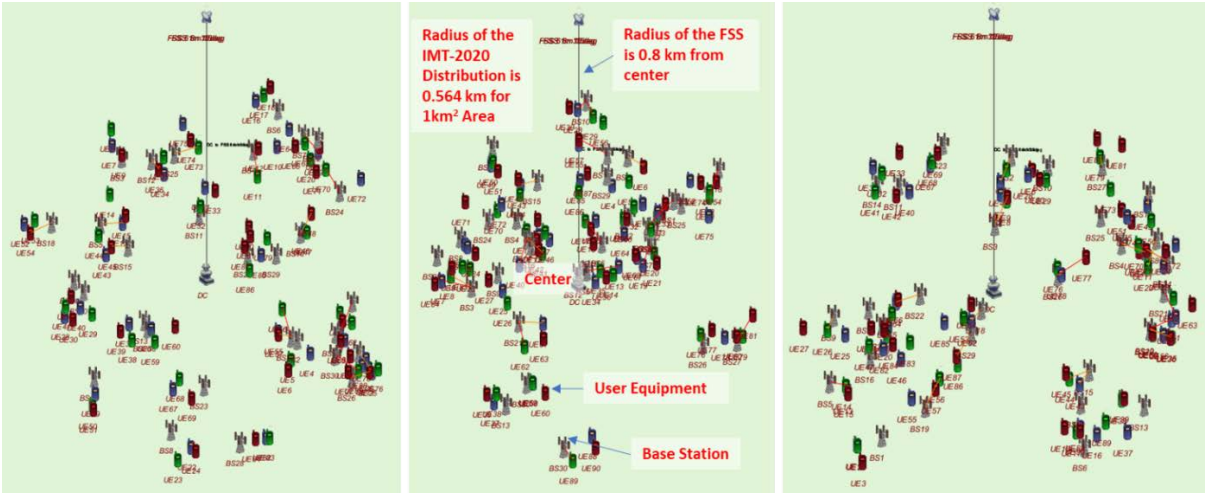


FIGURE 5

Scenario-2 Example of three one second snapshots showing the random placements of IMT-2020 in 1 km^2 area. The FSS stations are fixed at 0.8 km distance from centre point



The following assumptions are used for the interference calculations:

1 The IMT-2020 scenario is as described above;

2 The clutter models used for the interference link from IMT-2020 into the FSS receiver are from Document 5-1/38. Two models are used. The first is Recommendation ITU-R P.2001 “A general purpose wide-range terrestrial propagation model in the frequency

range 30 MHz to 50 GHz". The time percentages from 0 % to 100% are chosen randomly for each time sample. The other is Recommendation ITU-R P.2108 "Prediction of Clutter Loss" section 3.2. The clutter is applied at the IMT-2020 transmitter side as well as the FSS receiver side according to Recommendation ITU-R P.2108. The percent of locations for clutter is random between 0% and 100% for every sample;

3 The FSS centre frequency is 39 GHz;

4 FSS antenna height is 12 meters for the 1 m and 4 meters for the 6.8 m diameter antenna;

5 For each BS, three UE are employed at centre frequencies of 38.933 GHz, 39.0 GHz and 39.067 GHz;

6 Frequency dependent rejection (FDR) is accounted for;

7 Polarization loss is set to 3 dB;

8 The FSS protection criteria is under discussion within the ITU-R working parties. For this analysis we use -12.2 dB, -10 dB and -6 dB. The percent of time exceedance is needed to determine compatibility;

9 FSS bandwidths are 50 MHz and 500 MHz for the 1 m antenna and 100 and 600 MHz for the 6.8 m antenna;

10 The IMT-2020 emission mask in dBc and 60 MHz measurement bandwidth are shown below. Note that the emission masks are under discussion in ITU-R WP 5D;

11 The FSS receiver selectivity are shown below. The selectivity filters have -80 dB per decade slope from the -3 dB point to -70 dB floor.

FIGURE 6

Clutter loss

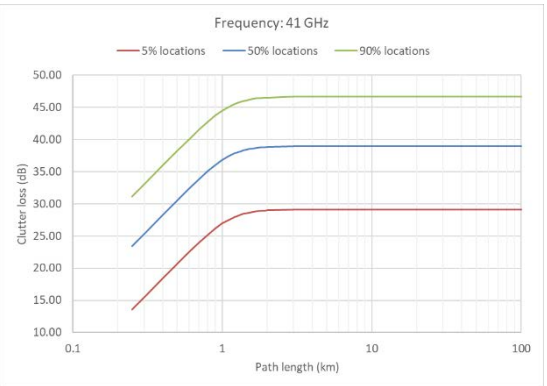


FIGURE 7

IMT-2020 emission masks
(Note: the emission masks are still under discussion in ITU-R WP-5D)

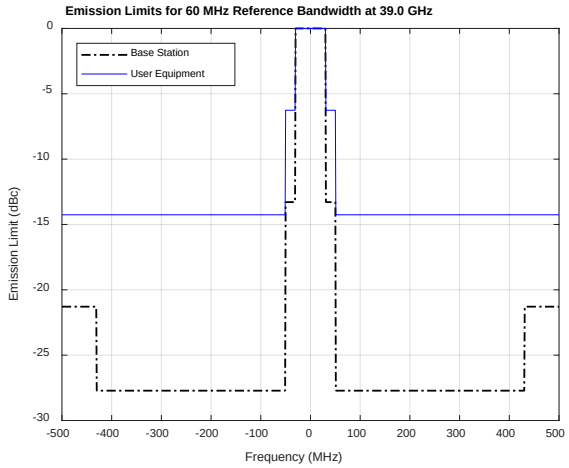
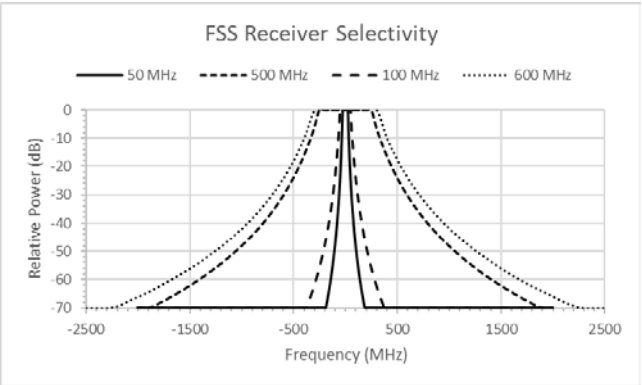


FIGURE 8

FSS receiver selectivity



1/1.2.5 Results for scenarios 1 to 3

The results of the simulations for the three scenarios are shown below.

TABLE 2

Scenario-1 IMT-2020 and FSS random locations
(Inside and outside the IMT-2020 distribution)

FSS Antenna Diameter (m)	1	1	1	1	6.8	6.8	6.8	6.8
FSS Antenna Height (m)	12	12	12	12	4	4	4	4
FSS Elevation Angle (°)	10	10	35	35	10	10	35	35
FSS Bandwidth (MHz)	50	500	50	500	100	600	100	600
Percent of time -12.2 dB is exceeded (%)	3.675	3.344	2.518	2.526	8.056	5.015	6.072	3.612
Percent of time -10 dB is exceeded (%)	2.810	2.126	1.973	1.396	6.522	3.576	4.844	2.404
Percent of time -6 dB is exceeded (%)	1.734	0.772	1.291	0.243	3.982	1.850	2.793	1.049

TABLE 3

Scenario-2 IMT-2020 random locations and FSS fixed location (800 m from centre)

FSS Antenna Diameter (m)	1	1	1	1	6.8	6.8	6.8	6.8
FSS Antenna Height (m)	12	12	12	12	4	4	4	4
FSS Elevation Angle (°)	10	10	35	35	10	10	35	35
FSS Bandwidth (MHz)	50	500	50	500	100	600	100	600
Percent of time -12.2 dB is exceeded (%)	0.153	0.066	0.015	0.022	0.233	0.094	0.039	0.026
Percent of time -10 dB is exceeded (%)	0.101	0.051	0.015	0.008	0.153	0.069	0.031	0.016
Percent of time -6 dB is exceeded (%)	0.030	0.035	0.009	None	0.080	0.042	0.014	None

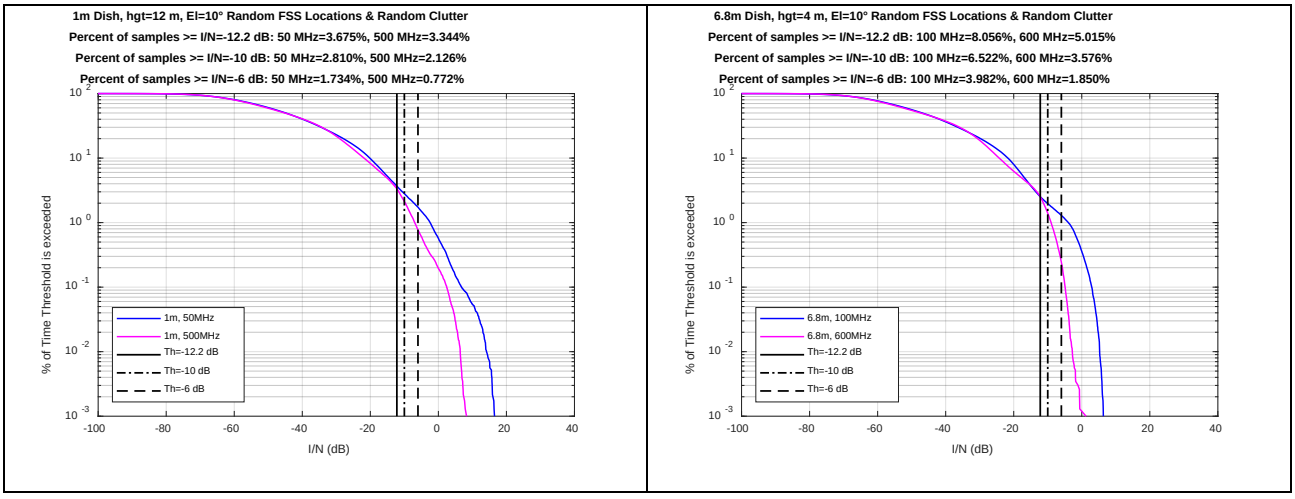
TABLE 4

Scenario-3 IMT-2020 random locations and FSS fixed location (1 100 m from centre)

FSS Antenna Diameter (m)	1	1	1	1	6.8	6.8	6.8	6.8
FSS Antenna Height (m)	12	12	12	12	4	4	4	4
FSS Elevation Angle (°)	10	10	35	35	10	10	35	35
FSS Bandwidth (MHz)	50	500	50	500	100	600	100	600
Percent of time -12.2 dB is exceeded (%)	0.002	None	None	None	None	None	None	None
Percent of time -10 dB is exceeded (%)	None	None	None	None	None	None	None	None
Percent of time -6 dB is exceeded (%)	None	None	None	None	None	None	None	None

TABLE 5

Scenario-1 IMT-2020 and FSS random locations CDFs



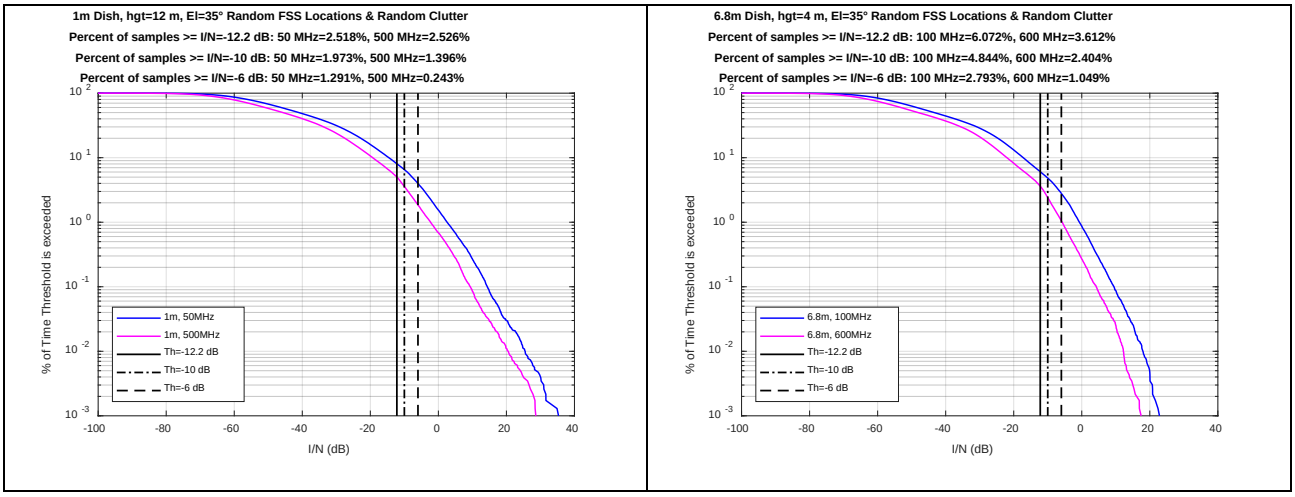


TABLE 6

Scenario-2 IMT-2020 random locations and FSS fixed location at 0.8 km from centre

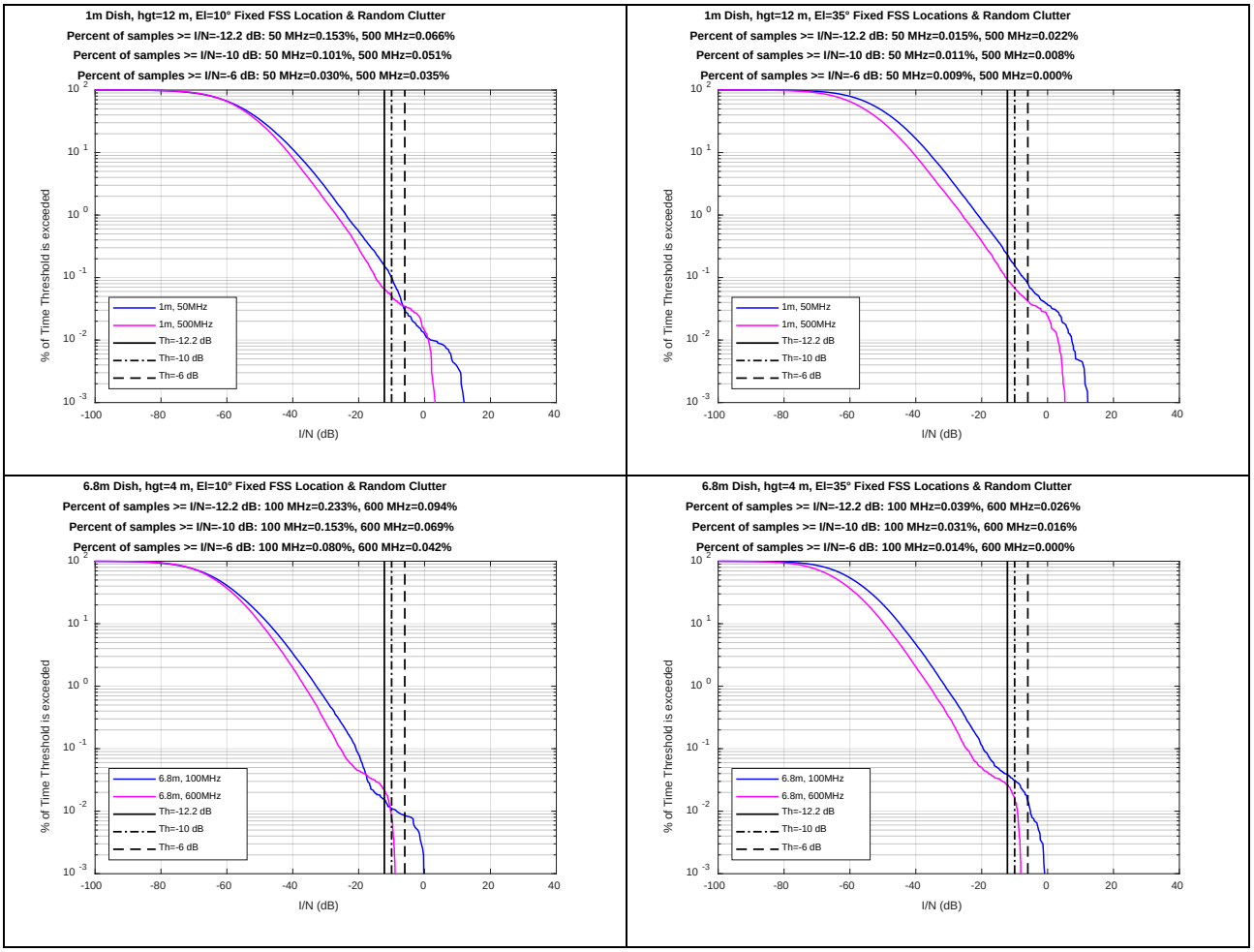
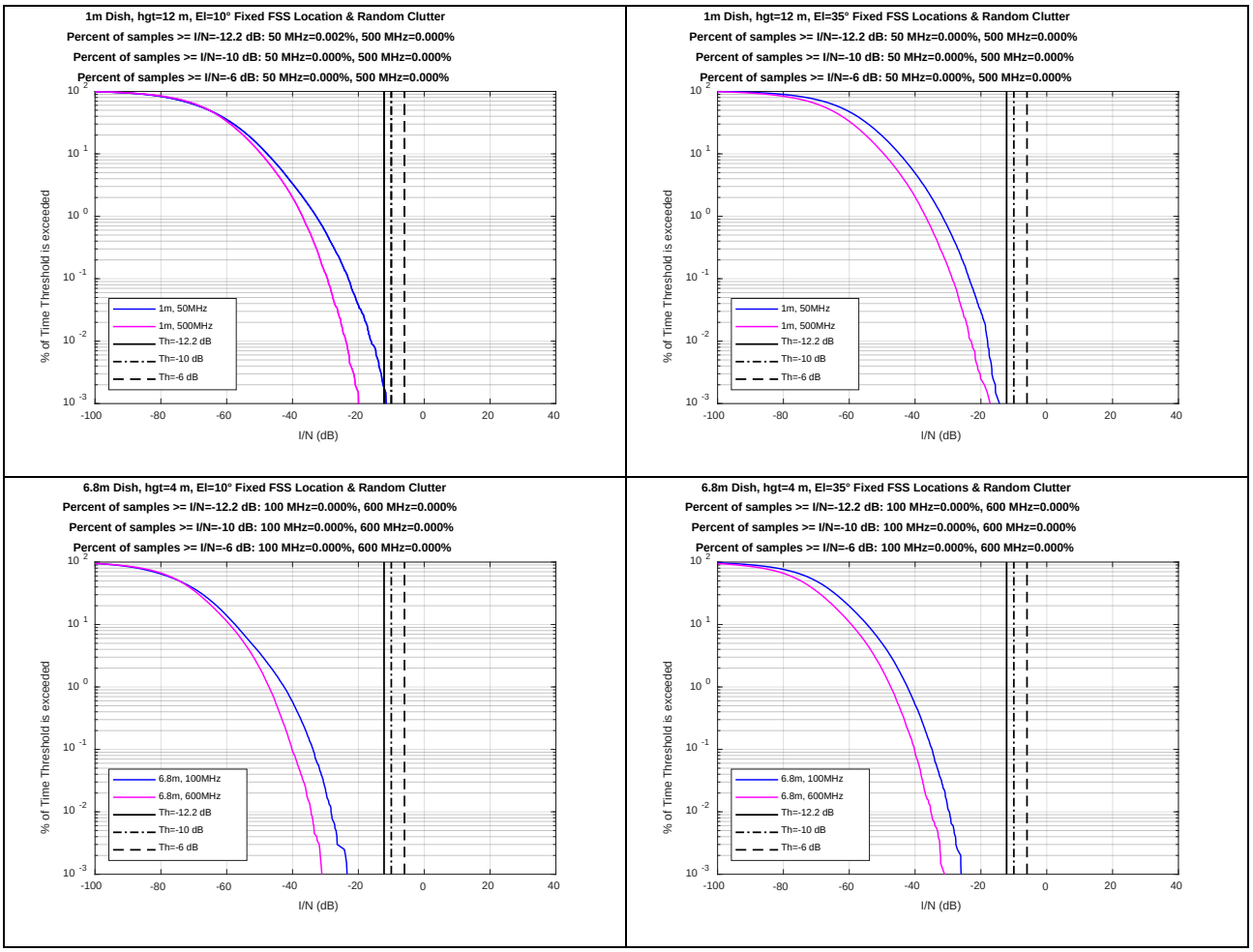


TABLE 7

Scenario-3 IMT-2020 random locations and FSS fixed location at 1.1 km from centre



1/1.2.6 Summary of results of Study B

The analysis above shows that when the FSS is placed at distance of about 1 100 m from the IMT-2020 distribution centre (or 540 m from the edge on the IMT-2020 coverage area for a circular coverage), the interference is almost non-existent. The interference does not exceed all three levels of protection criterion except for a single case where the I/N is exceeded by 0.002%, for the -12.2 dB I/N threshold, for the FSS antenna diameter of 1 meter with 50 MHz receiver bandwidth and pointing at an elevation angle of 10°. The distance of 1 100 m can potentially be refined and can become shorter depending on the selection of the protection criteria and the percent exceedance associated with it.

Please note that future results might be different depending on 3GPP response to Document 5D/666 liaison regarding the OOB emission masks levels.

1/3 Summary and analysis of the results of studies

[*Note: Concise text with summary and analysis of the results of above studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect existing service/application(s) operating in the band [XX-YY] GHz, or in adjacent band as appropriate.*]

[No Changes to Attachment 2 and 3]